fact that radium gives rise to rays charged with negative electricity. Our researches upon the new radio-active bodies have given rise to a scientific movement, and have been the starting point of numerous researches in connection with new radio-active substances, and with the investigation of the radiation of the known radio-active bodies."

THE additions to the Zoological Society's Gardens during the past week include two Black-eared Marmosets (*Hapale penicillata*) from South-east Brazil, presented by Mr. J. Arthur Turner; a Short-toed Eagle (*Circaëtus gallicus*) captured at sea, presented by Lieut. W. H. Colegrave, R.N.R.; four Chameleons (*Chamaeleon vulgaris*) from North Africa, presented by Mr. Thomas Yates; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, two Slender Loris (*Loris gracilis*) from Ceylon, a Blue-fronted Amazon (*Chrysotis aestiva*), a Rough-eyed Cayman (*Caiman sclerops*), five Black-pointed Teguexins (*Tupinambis nigropunctatus*) from South America, a Red-billed Toucan (*Ramphastos erythrorhynchus*) from Cayenne, two Red-handed Tamarins (*Midas rufimanus*) from Surinam, a One-bearded Greaved Tortoise (*Podicnemis unifilis*) from the Upper Amazons, deposited.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF SOLAR PHENOMENA.—In a paper presented to the Paris Académie des Sciences, M. Deslandres discusses the various theories concerning the inter-relation of solar and magnetic phenomena which have been brought into prominence by the exceptional magnetic storm of October 31. He points out that, whereas the magnetic phenomena are recorded continuously at many widely separated observatories, the solar observations, which constitute the other side of the problem under discussion, are only made during short intervals each day and at fewer stations; therefore he strongly urges that solar observatories should be more widely disseminated in order that a *continuous* record may be obtained. Again, he points out that, at present, at least ninety-nine out of every hundred observers of the sun only record the *forms*, and not the *movements*, or velocities, of the solar disturbances, whereas in his opinion the records of the latter would prove much more effective in bringing us to a solution of the vexed questions.

M. Deslandres suggested in 1893, and in the present paper he strongly emphasises the fact, that it is essential, in order that our knowledge of solar disturbances may be rendered less defective, to obtain a *continuous* record of:—(1) The surface of the photosphere as photographed by the ordinary process; (2) the *forms* of the disturbances in the lower, mean, and higher chromosphere as obtained with the spectroheliograph; and (3) the radial velocities of these chromospheric disturbances as shown on photographs obtained with the spectroheliograph especially arranged to register these velocities. He states that the present instruments are perfect enough to ensure success, and estimates the annual expense of such observations (at Meudon) as twenty thousand francs (about 800*l*.) (*Comptes rendus*, No. 21, November 23).

THE SPECTRUM OF LIGHTNING.—Mr. Phillip Fox, of the Yerkes Observatory, has recently succeeded in obtaining several spectra of lightning flashes which were taken with an objective-prism spectroscope consisting of a 30° flint glass prism mounted in front of a camera of 35 mm. aperture and 274 mm. focal length. Proceeding on the lines suggested by the visual observations of Vogel, Lohse, and Schuster, he compared his spectra with a spark spectrum of air obtained with the same instrument, and found that a striking agreement existed between the two.

Similar results were arrived at by Dr. W. J. S. Lockyer, who, in a recent number of the *Illustrated Scientific News* (No. 15, vol. ii.), described an extremely simple method whereby photographs of lightning flashes and their spectra can be obtained by using an ordinary camera having one of Thorpe's transmission gratings fixed in front of the lens. The spectra thus obtained by Dr. Lockyer in May of this year are shown to differ from those obtained by Prof. Pickering at Harvard in 1901, and a spectrum recently obtained by the latter is again different from either of the other two; all, however, bear a striking resemblance, in general appearance, to the air spark spectrum, the chief nitrogen lines being especially prominent.

In Mr. Fox's spectra it is seen that the various lines differ in intensity from one part of the flash to another, and, as this apparently indicates a variation of the spectrum with the atmospheric conditions, it seems probable that the differences existing between the several spectra may be thus explained.

Mr. Fox's article is illustrated by reproductions of the spectra obtained by him, and a comparison of the air and lightning spectra, and is published in No. 4, vol. xviii., of the *Astrophysical Journal*.

THE LINE SPECTRA OF THE ALKALINE METALS.—In No. 27 of the *Physikalische Zeitschrift* Herren H. Konen and A. Hagenbach record the results of some observations made by them with the object of discovering additional lines in the secondary series of the spectra of lithium, potassium, cæsium, and rubidium.

In the spectrum of lithium four new lines were observed, but their diffuse character renders the determined wave-lengths (6240·8, 4636·14, 4149·1, and 3934) rather untrustworthy, and for this reason it is difficult to determine finally whether they belong to a definite series or not, although it seems likely, from their character and their analogy to the lines in the sodium series, that they are really pairs, and belong to the first secondary series. No new lines were discovered in the potassium spectrum. In the spectrum of rubidium three new lines were discovered, and fourteen of the fifteen lines observed by Mr. Hugh Ramage in the flame spectrum were seen, although these observers were unable to find, either in the arc or the flame, the line at λ 5037 recorded by Mr. Ramage. These new lines fill up gaps in the first secondary series as calculated from Kayser and Runge's formula.

All the lines recorded by Mr. Ramage below λ 5750 in the cæsium spectrum were observed, together with an additional line at λ 5209.

PATAGONIAN "DIPROTODONT" MAMMALS.[1]

SEÑOR AMEGHINO appears to be firmly convinced that the ancestors of a large number of groups of mammals are to be met with among the remains from the Santa Cruz and associated beds of Patagonia. Last year, in the journal quoted below, he attempted to prove the descent of the modern elephant, through Pyrotherium and certain other forms, from a primitive opossum (Proteodidelphys). Now he essays to demonstrate that the rodents have originated from another type of Patagonian "diprotodonts," namely, the Garzoniidæ, which is itself traced back to a still earlier group, the Microbiotheriidæ. Apart from zoological considerations, the possibility of such phylogenies depends entirely on the age assigned to the Santa Cruz and subjacent strata. If, with Dr. Ameghino, we regard them as of early Eocene, Cretaceous, and possibly Upper Jurassic age, then, from this point of view, there is nothing impossible in such pedigrees. If, on the other hand, we accept the view of the great majority of palæontologists that these strata are of Miocene age, the very foundations of Dr. Ameghino's elaborate phylogenies are at once destroyed.

Putting, however, this consideration on one side, we may refer briefly to some of the zoological features in the paper before us. Briefly stated, Dr. Ameghino's views, so far as we can follow them, appear to be as follows. In the Upper Jurassic of Patagonia there existed a primitive group of "diprotodonts" (that is to say, mammals furnished with a single pair of chisel-like incisors in the lower jaw), the Microbiotheriidæ. On the one hand, as we learn from the earlier paper, these gave rise to the Proboscidea, while on the other they culminated in the modern rodents, the diprotodont marsupials of Australia, and certain extinct forms,

[1] F. Ameghino, "Los Diprotodontes del ordren des los Plagiaulacoideos y el Origen de los Roedores y de los Polymastodontes" (*An. Mus. Nac. Buenos Aires*, vol. ix., pp. 81–192)

such as Plagiaulax of the Purbeck and Microlestes of the Trias (!). The author appears, indeed, to consider that, with the exception of Pyrotherium (which, despite its remarkable resemblance to Diprotodon, he places in the proboscidean line), all mammals with a diprotodont type of dentition are related to one another. And he endeavours to show that the dentition of one type passes by imperceptible degrees into that of another. But such gradations may be traced between the dentition of almost any groups, and no allowance whatever is made for parallelism in development, which has undoubtedly been an important factor in evolution. Moreover, no account whatever is taken of the undoubted resemblance existing between the cheek-teeth of the polymastodonts and the reptilian Tritylodon.

Then, again, according to the author's scheme, the true diprotodonts of Australia have no relationship with the polyprotodont marsupials of the same region, which is, on the face of it, an absurdity. It may also be pointed out that Dr. Ameghino takes no account of the work of other palæontologists. It is very generally accepted, for instance, that an intimate relationship exists between marsupials (as a whole) with the extinct creodonts, and so with the modern Carnivora (see Wortman, *Amer. J. Sci.*, vol. xiv., 144, 1902), while Prof. Osborn (*Bull. Amer. Mus.*, xvi. p. 203, 1902) has indicated the probability of the descent of the rodents from the Holarctic Eocene Mixodectidæ. Obviously both these phylogenies must be demonstrated false before there is even a *primâ facie* possibility for Dr. Ameghino's scheme. It will be interesting to learn what the United States palæontologists have to say on the subject when the groups in question come to be treated in the working out of the Hatcher collection. R. L.

GEOLOGICAL NOTES.

OBSERVATIONS have been made by Mr. R. D. Oldham on the growth of sandhills, which threaten to cut off communication between the town of Karachi and the suburb of Clifton, two or three miles distant (*Mem.* Geol. Surv. India, xxxiv., part iii.). He traces out the growth of dunes from small oval patches of sand which begin to accumulate on irregular tracts of the stony surface, pointing out that even a slight accumulation may cause an upward bend of the air currents whereby a space of comparative calm is produced, and sand more readily comes to rest. In course of time the oval patches of sand are heaped up with a sharper slope to leeward, down which the sand grains fall. Here a hollow is produced by an eddy of the wind, and this eddy serves to maintain and increase a crescentic form with a crater-like opening. The principal winds at Clifton blow from W.S.W., and form the main features in the sandhills; but winds from the E.N.E. blow during the winter months, causing a reverse slope and a bank of sand to be formed near the summit of the long gentle slope which faces the W.S.W. winds. There is a good deal of scour of the original steep leeward slope, but no complete reversal of the shape of the sandhill.

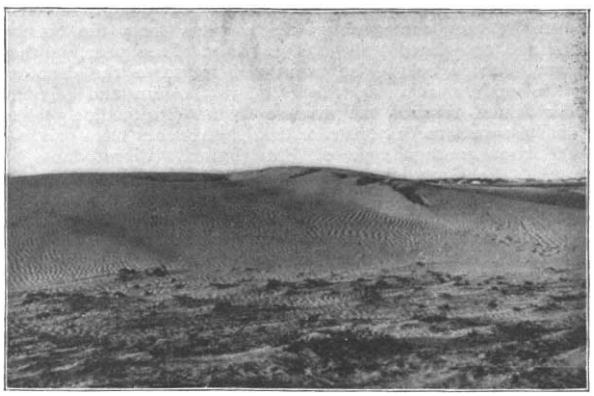

FIG. 1.—Sandhill near Clifton, Karachi, showing change of form and scour by wind.

Mr. Oldham points out that the original hollow is well shown in the accompanying view. The sandhill was first shaped by W.S.W. winds, then a period of E.N.E. winds caused a partial modification of form, heaping up the sand from that side and producing the steep slope facing to left of the picture. The sandhill was afterwards attacked by a S.W. wind, which commenced to reshape it, and this alteration at first led to the formation of notches in the crest, in which the wind became concentrated, leading to a violent scour and to the excavation of deep pits to leeward. The furthest of the notches has been cut down nearly to the foot of the steep slope. Eventually it and the other notches will be widened, and the intervening pinnacles will be lowered until the crest is reduced to a smoothly rounded outline. Mr. Oldham discusses the means which may be taken to arrest the progress of the sandhills, and concludes that much may be done by encouraging the growth of local grasses.

In an essay on the deformation of rocks, Mr. E. H. L. Schwarz (*Trans.* S. African Phil. Soc., xiv., part iv.) discusses their crushing strength, and remarks that this is less when the specimen tested is soaked in water. In natural circumstances in the earth's crust the crushing value of a column of rock, which would crush the layer at its foot, must be estimated by the weight of the material in water, and the author calculates that a column of sandstone must be from about two-thirds of a mile to five miles in height, one of granite from four to seven and a half miles, and one of felsite from seven to nine miles. The actual zone of mass deformation seems to be much nearer the surface, judging by the "creep" in mine-levels, and by the fact, in the case of deep bore-holes, that a cylinder of rock gradually rises from the bottom. The author alludes to the effect that crushing would produce along the bases of deep gorges, and he points out that the line of inquiry indicates that there must be a limit to the height of mountains and to the thickness of ice-sheets. He further discusses the deformation of rocks at great depths by the action of water.

In the *Proceedings* of the Royal Society of Victoria (n.s. vol. xvi. part i.), Mr. F. Chapman describes some new species of Silurian Polyzoa and Brachiopoda. Prof. J. W. Gregory discusses the formation of the Henty peneplain in N.W. Tasmania. In places it is 1300 feet or more above the sea, but is lower towards the north, west, and south. It appears to have been due to river-action in pre-Glacial times, when western Tasmania stood a few hundred feet lower than it does now. Its comparatively recent uplift is shown by the King River, which, east of Mount Lyell, flows through a very ancient flat-floored valley, and then traverses the peneplain in a sinuous narrow canyon.

An elaborate memoir on the Jurassic Trigoniæ of Cutch has been contributed by Dr. F. L. Kitchin to the *Memoirs* of the Geological Survey of India (Pal. Ind., ser. ix., vol. iii., part ii., No. 1). Most of the species of Trigonia have been obtained from the Putchum-Charee series, which, on the evidence of Cephalopoda, has been grouped with the European Bathonian, Callovian, and Oxfordian strata. In no case has Dr. Kitchin been able to identify any of the Cutch Trigoniæ with European species, but while they afford no definite evidence of the correlation above mentioned, they present no obstacles to its acceptance. They flourished in a different zoological province, but the Lower Charee (Callovian) forms bear the imprint of a facies which characterised a slightly earlier age in Europe, a fact suggestive of migration into the Cutch area. No Trigoniæ have been obtained from the Katrol (Kimeridgian) strata, but in the overlying Oomia beds, which appear to be transitional between Jurassic and Cretaceous, there are Trigoniæ that approximate in adult characters to forms found in the Uitenhage strata of South Africa. There is other evidence which suggests community between the Jura-Cretaceous faunas of the two areas, but as the forms in question differ widely in their youthful characters, Dr. Kitchin regards them as indicating homœomorphous derivation from separate stocks. Evolution of this character may have taken place under similar conditions, but it does not imply contemporaneity. The subject is of great im-